
INDEX TO UREDINEOUS CULTURE EXPERIMENTS WITH LIST OF SPECIES AND HOSTS FOR NORTH AMERICA.

W. A. KELLERMAN.

(*Abstract.*)

Careful culture work to determine life histories of fungi or cycles of development was initiated by De Bary in 1865. It was continued by him in 1866 and in the same year also taken up by Oersted and Woronin. A few years later other foreign botanists engaged in similar work, and the list continued to the present contains such additional names as Schroeter, Rostrup, Winter, Schenk, Cornu, Plowright, Klehban, Hartig, Dietel, Barclay, Fischer, Tubeuf, Soppit, Tranzschal, Eriksson, Pazschke, Juel, Wagner, Bubak, Jacky, Shirai, Müller and Ward.

In America Dr. Farlow was the pioneer worker, publishing his first experiments on the "Gymnosporangia or Cedar Apples of the United States" in 1880. He continued work on the same group in 1885, and it was supplemented (independently) by Halsted in 1886-7, published in the Bulletin of the Iowa Agricultural

College. More fruitful results were obtained by Thaxter in 1887 and again in 1889,—the connection between the several species of Gymnosporangium and associated Roestelia occurring in this country being satisfactorily established, which may be found in print in the Proceedings of the American Academy of Arts and Sciences, Boston; and Bulletin 134, Conn. Agr. Exp. Sta. Pammel repeated the experiment verifying connection in case of one of the species (Ia. Hort. Soc. Rep. 1893), the same also by Stewart and Carver (Proc. Ia. Acad. Sci. for 1895, Vol. 3; same in N. Y. Exp. Sta. for 1895).

No connections between Uredineous forms were then experimentally determined—except that Howell (in 1890) showed the three stages of the Clover Rust to be genetically related, and Clinton (in 1894) the two stages of the Bramble Rust—until 1899, when extended and important work was reported by Arthur and by Carleton. The latter dealt with the Cereal Rusts only, making sowings almost exclusively of Uredospores mainly from Wheat, Oats, Barley, Rye and Maize, on the same and on different host species. The interesting results were published as Bulletin No. 16, U. S. Dept. Agr. Div. Veg. Physiology and Pathology, April 23, 1899.

Arthur communicated his first results to the public in a paper read before the A. A. A. S., Botanical Section, Columbus, Ohio, August, 1889, and the same was published in the Botanical Gazette, 29: 268-276, April, 1900. Of eleven species of Uridineae, the aecidial and teleutosporic forms were definitely connected by these cultures. In the Journal of Mycology (8: 51-6), June, 1902, he reported cultures made in 1900 and 1901—successful inoculations in eight cases, four being repetitions of previously demonstrated connections, and the complete cycle for four being reported here for the first time. Arthur's third report (cultures in 1902) was published in the Botanical Gazette (35: 10-23) for January, 1903. The successful cultures made number eleven previously reported and seven reported for the first time.

In 1902 cultures were undertaken by Kellerman. The first case of demonstrated connection was published in the Journal of Mycology (8: 20), May, 1902, and appeared in the same periodical (9: 6-13) in February, 1903. This showed seven successful inoculations, two of these not having been previously demonstrated. The second report (continuing his work during 1903), detailing more extended cultures, was given in part in the Journal of Mycology (9: 109-10), May, 1903, and the year's work is reported in full in the Journal, December Number, 1903.

This brief historical outline shows that as yet comparatively few American mycologists have undertaken culture work to determine life cycles of our numerous species of Uredineae.

Space precludes giving here a detailed record of work by American botanists, but the paper in full is published in the Journal of Mycology, also printed *on one side of page* as a SEPARATE. The following is a summary of the alternate forms whose connection has been demonstrated :

SUMMARY OF ALTERNATE FORMS.

- Aecidium albiperidium* Arth.—*Puccinia albiperidia* Arth.
Aecidium asteratum Schw.—*Puccinia caricis-asteris* Arth.
Aecidium berberidis Pers.—*Puccinia poculiformis* (Jacq.) Wettst.
Aecidium calystegiae Desm.—*Puccinia convolvuli* Cast.
Aecidium caulicolum Kellerm.—*Puccinia caulicola* Tr. & Gall.
Aecidium cirsii-lanceolati Kellerm.—*Puccinia cirsii lanceolati* Schroet.
Aecidium ellisii Tr. & Gall.—*Puccinia subnitens* Diet.
Aecidium erigeronatum Schw.—*Puccinia caricis-erigerontis* Arth.
Aecidium euphorbiae Am. Auct.—*Uromyces euphorbiae* C. & P.
Aecidium fraxini Schw.—*Puccinia fraxinata* (Lk.) Arth.
Aecidium on *Helianthus*—*Puccinia helianthi* Schw.
Aecidium hibisci Schw.—*Puccinia hibisciata* (Schw.) Kellerm. (*P. muhlenbergiae* Arth. & Holw.)
Aecidium hydnoideum B. & C.—*Puccinia hydnoidea* (B. & C.) Arth.
Aecidium impatientis Schw.—*Puccinia impatientis* (Schw.) Arth. (*P. rubigovera* Auct. on *Elymus virginicus*.)
Aecidium jamesianum Pk.—*Puccinia jamesiana* (Pk.) Arth. (*P. bartholomaei* Diet.)
Aecidium on *Larix decidua*, *see* *Caeoma* on *Larix decidua*.
Aecidium lateripes Kellerm.—*Puccinia lateripes* B. & Rav.
Aecidium leucospermum B. & C.—*Uromyces lespedezae-procumbentis* (Schw.) Curt.
Aecidium lycopi Ger.—*Puccinia angustata* Pk.
Aecidium oenotherae Pk., *see* *Aecidium peckii* DeToni.
Aecidium pammelii Trel.—*Puccinia panici* Diet.
Aecidium peckii DeToni (*Ae. oenotherae* Pk.)—*Puccinia peckii* (DeToni) Kellerm. (*P. caricis* Auct. p. p.)
Aecidium pentstemonis Schw.—*Puccinia andropogonis* Schw.
Aecidium plantaginis Ces. (?) on *Plantago rugelii* Dec.—*Uromyces aristidiae* E. & E.
Aecidium pteleae B. & C.—*Puccinia windsoriae* Schw.
Aecidium pustulatum Curt.—*Puccinia pustulata* (Curt.) Arth.
Aecidium [ranunculacearum (?)] on *Anemone canadensis* L.—*Puccinia similissima* Arth.
Aecidium ranunculi Schw.—*Puccinia eatoniae* Arth.
Aecidium rhamni Pers.—*Puccinia rhamni* (Pers.) Wettst. (*P. coronata* Corda.)
Aecidium rubellum Pers.—*Puccinia phragmitis* Schum.
Aecidium sambuci Schw.—*Puccinia sambuci* (Schw.) Arth. (*P. atkinsoniana* Diet., *P. bolleyana* Sacc.)
Aecidium smilacis Schw.—*Puccinia amphigena* Diet.
Aecidium solidaginis Schw.—*Puccinia caricis-solidaginis* Arth.
Aecidium on *Solidago*—*Uromyces solidagini-caricis* Arth.

- Aecidium* on *Strophostyles helvola*—*Uromyces phaseoli* (Pers.) Wint.
Aecidium on *Trifolium*, *see Uromyces trifolii* (A. & S.) Wint.
Aecidium urticae Schum.—*Puccinia caricis* (Schum.) Reb.
Aecidium verbenicola K. & S.—*Puccinia vilfae* A. & H.
Caecoma (*Aecidium*) *erigeronatum* Schw., *see Aecidium erigeronatum* Schw.
Caecoma (*Aecidium*) *hibisciatum* Schw., *see Puccinia hibisciata* (Schw.) Kellerm.
Caecoma on *Larix decidua*—*Melampsora medusae* Thüm. [*M. populina* Am. Auct.]
Caecoma miniata Am. Auct.—*Phragmidium speciosum* Fr.
Caecoma nitens Schw., *see Gymnoconia interstitialis* (Schlecht.) Lagh.
Caecoma ulmariae Thüm.—*Triphragmium ulmariae* (Schum.) Lk.
Gymnoconia interstitialis (Schlecht.) Lagh., *aecidium* (*Caecoma nitens* Schw.), and *teleuto* (*Puccinia peckiana* Howe); *autoecious*.
Gymnosporangium biseptatum Ell.—*Roestelia botryapites* Schw.
Gymnosporangium clavariaeforme (Jacq.) Rees.—*Roestelia lacerata* (Sow.) Fr.
Gymnosporangium clavipes Cke. & Pk.—*Roestelia aurantiaca* Peck.
Gymnosporangium conicum Rees.—*Roestelia cornuta* (Ehr.) Fr.
Gymnosporangium ellisii (Berk.) Farl.—*Roestelia transformans* Ellis (?).
Gymnosporangium globosum Farl.—*Roestelia globosum* ("lacerata z") Thaxter.
Gymnosporangium macropus Lk.—*Roestelia pyrata* Thaxter.
Gymnosporangium nidus-avis Thaxter—*Roestelia nidus-avis* Thaxter.
Melampsora medusae Thüm [*M. populina* Am. Auct.]—*Caecoma* on *Larix decidua*.
Melampsora populina Am. Auct., *see Melampsora medusae* Thüm.
Phragmidium speciosum Fr.—*Caecoma miniata* Am. Auct.
Puccinia albiperidia Arth., *aecidium* [*albiperidium* Arth.], *uredo* and *teleuto*; *autoecious*.
Puccinia americana Lagh., *see Puccinia andropoginis* Schw.
Puccinia amphigena Diet.—*Aecidium smilacis* Schw.
Puccinia andropoginis Schw. (*P. americana* Lagh.)—*Aecidium pentstemonis* Schw.
Puccinia angustata Pk.—*Aecidium lycopi* Ger.
Puccinia atkinsoniana Diet. *see Puccinia sambuci* (Schw.) Arth.
Puccinia bartholomaei Diet., *see Puccinia jamesiana* (Pk.) Arth.
Puccinia bolleyana Sacc., *see Puccinia sambuci* (Schw.) Arth.
Puccinia caricis (Schum.) Reb.—*Aecidium urticae* Schum.
Puccinia caricis Am. Auct. p. p. (*P. peckii* DeToni) Kellerm., *see P. peckii* (DeToni) Kellerm.
Puccinia caricis-asteris Arth.—*Aecidium asteratum* Schw.
Puccinia erigerontis Arth.—*Aecidium erigeronatum* Schw.
Puccinia caricis-solidaginis Arth.—*Aecidium solidaginis* Schw.
Puccinia caulicola Tr. & Gall., *aecidium* [*caulicolum* Kellerm.], *uredo* and *teleuto*; *autoecious*.
Puccinia cirsii-lanceolati Schroet., *aecidium* [*cirsii-lanceolati* Kellerm.], *uredo* and *teleuto*; *autoecious*.
Puccinia convolvuli Cast., *aecidium* [*calystegiae* Desm.], *uredo* and *teleuto*; *autoecious*.
Puccinia coronata Corda, *see Puccinia rhamni* (Pers.) Wettst.
Puccinia eatoniae Arth.—*Aecidium ranunculi* Schw.

- Puccinia fraxinata* (Lk.) Arth.—*Aecidium fraxini* Schw.
Puccinia graminis, see *Puccinia poculiformis* (Jacq.) Wettst.
Puccinia helianthi Schw., aecidium [*Caeoma helianthi* Schw.], uredo and teleuto; autoecious.
Puccinia hibisciata (Schw.) Kellerm. (*P. muhlenbergiae* Arth. & Holw.)—*Aecidium hibisciatum* Schw.
Puccinia hydnoidea (B. & C.) Arth.—*Aecidium hydnoideum* B. & C.
Puccinia impatientis (Schw.) Arth. (*P. rubigo-vera* Auct. on *Elymus virginicus*)—*Aecidium impatientis* Schw.
Puccinia jamesiana (Pk.) Arth. (*P. bartholomaei* Diet.)—*Aecidium jamesianum* Pk.
Puccinia lateripes B. & Rav., aecidium [*lateripes* Kellerm.], uredo and teleutospores; autoecious.
Puccinia muhlenbergiae Arth. & Hol., see *Puccinia hibisciata* (Schw.) Kellerm.
Puccinia panic Diet.—*Aecidium pammeli* Trel.
Puccinia peckiana Howe, see *Gymnoconia interstitialis* (Schlecht.) Lagh.
Puccinia peckii (DeToni) Kellerm. (*P. caricis* Am. Auct. p. p.)—*Aecidium peckii* DeToni (Ae. *oenotherae* Pk.).
Puccinia peridermiospora (E. & T.) Arth., see *Puccinia fraxinata* (Lk.) Arth.
Puccinia phragmitis (Schum.) Körn.—*Aecidium rubellum* Pers.
Puccinia poculiformis (Jacq.) Wettst.—*Aecidium berberidis* Pers.
Puccinia pustulata (Curt.) Arth.—*Aecidium pustulatum* Curt.
Puccinia rhamni (Pers.) Wettst. (*P. coronata* Corda)—*Aecidium rhamni* Pers.
Puccinia rubigo-vera Am. Auct. on *Elymus virginicus*, see *Puccinia impatientis* (Schw.) Arth.
Puccinia sambuci (Schw.) Arth. (*P. atkinsoniana* Diet., *P. bolleyana* Sacc.)—*Aecidium sambuci* (Schw.) Arth.
Puccinia simillima Arth.—*Aecidium* [*ranunculacearum* (?)] on *Anemone canadensis* L.
Puccinia subnitens Diet.—*Aecidium ellisii* Tr. & Gall.
Puccinia vilfae A. & H.—*Aecidium verbenicola* K. & S.
Puccinia windsoriae Schw.—*Aecidium pteleae* B. & C.
Roestelia aurantiaca Pk.—*Gymnosporangium clavipes* Cke. & Pk.
Roestelia botryapites Schw.—*Gymnosporangium biseptatum* Ell.
Roestelia cornuta (Ehr.) Fr.—*Gymnosporangium conicum* Rees.
Roestelia globosum ("lacerata z") Thaxter—*Gymnosporangium globosum* Farl.
Roestelia lacerata (Sow.) Fr.—*Gymnosporangium clavariaeforme* (Jacq.) Rees.
Roestelia nidus-avis Thax.—*Gymnosporangium nidus-avis* Thaxter.
Roestelia pyrata Thaxter—*Gymnosporangium macropus* Lk.
Roestelia transformans Ell. (?)—*Gymnosporangium ellisii* (Berk.) Farl.
Triphragmium ulmariae (Schum.) Lk.—*Caeoma ulmariae* Thüm.
Uromyces aristidae E. & E.—*Aecidium plantaginis* Ces. (?) on *Plantago rugelii* Dec.
Uromyces solidagini-caricis Arth.—*Aecidium* on *Solidago*.
Uromyces euphorbiae C. & P.—*Aecidium euphorbiae* Am. Auct.
Uromyces lespedezae-procumbentis (Schw.) Curt., aecidium [*leucospermum* B. & C.], uredo and teleuto; autoecious.
Uromyces phaseoli (Pers.) Wint., aecidium, uredo and teleuto; autoecious.
Uromyces trifolii (A. & S.) Wint., aecidium, uredo and teleuto; autoecious.